Reorganization and Relocation of the Battlefield Environment Division of the U S Army Research Laboratory

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Abstract

Current organization, strength, and technology thrusts are presented for the US Army Research Laboratory (ARL) Battlefield Environment Division (BED). Near-term tactical weather deliverables for the Army's artillery and intelligence customers are discussed. Generalized funding and long-range research goals are discussed. 1991 Base Realignment and Closure (BRAC) requirements for relocating portions of the former Atmospherics Sciences Laboratory at White Sands, NM, are reviewed. Subsequent restructuring of ARL and current alignment of atmospheric sciences research continues at the US Army Research Lab, Adelphi, MD, and White Sands Missile Range, NM.

1. Introduction

Over the last year, two efforts have been completed which resulted in the reorganization and relocation of the Battlefield Environment Division, which was formerly the independent Atmospheric Sciences Laboratory located in White Sands Missile Range, New Mexico, and then the Battlefield Environment Directorate of the Army Research Laboratory. The first of these was the movement of the atmospherics effects mission from White Sands to Adelphi, Maryland, as a result of the Base Realignment and Closure Act of 1991. This move coincided with the construction of new facilities to receive the 56 research positions transferred to Adelphi. A new $2.3 million High Bay building was completed in October, 1996, to house the electro-optics and adaptive intelligent optics laboratories, and a new site for atmospherics/acoustics propagation studies is currently being constructed at Blossom Point, Maryland. The second effort was the internal reorganization of the Army Research Laboratory from 11 original directorates to 5 new directorates. One of these directorates, Information Science and Technology, was formed consolidating all or part of three directorates with nine division and ended in a structure of three divisions, of which the Battlefield Environment Division is the largest.

2. Division Mission

The United States Army Research Laboratory (ARL) Battlefield Environment Division (BE) of the Information Sciences and Technology Directorate is the lead Department of Defense organization for research and development in the portion of the atmosphere unique to the Army warfighter's battlespace--the planetary boundary layer. BE's mission is to "Own the Weather" (OTW) by providing atmospheric effects information to decision makers on the battlefield in planning and executing operations. The joint Army/Air Force OTW initiative will provide knowledge of current and forecast battlefield environment conditions, along with their effects on systems, soldiers, operations, and tactics, to provide a decisive advantage over opponents. Succinctly stated, the mission is to own the weather by advancing our understanding of the atmosphere and its critical relationship to performance of Army systems operations. To do this, BE acts to develop, acquire and integrate new atmospheric science technologies that enable Land Force Dominance. Annual mission funding for this mission is on the order of $11 million excluding customer funding from outside agency sources.

Under the DOD Project Reliance taxonomy, BE is the lead agency for multi-service programs in transport and diffusion modeling and mobile atmospheric profiling, with the latter technology transferring out of BE to advanced engineering development in FY 99. In addition, BE contributes to tri-service goals in the areas of theater data fusion

and predictions, boundary **layer processes, and** atmospheric effects. The branches remaining at White Sands are the Weather Exploitation and Artillery Meteorology Branches. The branches at Adelphi are the Atmospheric Effects and Synthetic Environments Branches.

The BE program is driven by the Army's need for boundary layer meteorological information at scales smaller than those used by either the Air Force, Navy, or civilian community, and over data sparse geographic regions. The requirement to host this capability on Army tactical hardware further impacts the research and development programs.

3. **Specific** Division Functions

Listed below are the specific functions provided by the Battlefield Environment Division:

(1) Direct atmospheric sciences programs consistent with priority Army requirements; and manage the division's research, development, and applications plans.

(2) Provide executive management, advice, and assistance for the division and manage division resources.

(3) Recommend the establishment of appropriate technical plans, policies, and procedures; serve as the point of contact (POC) on matters related to technical plans and programs.

(4) Analyze potential customer requirements and foster effective customer relationships.

(5) Prepare the division's portion of planning and marketing documents, and coordinate technical planning and marketing with ARL to ensure technical plans agree with ARL strategy and business plan.

(6) Coordinate and consolidate the technical program, monitor implementation, and review and analyze accomplishment of directorate objectives, including the WEATHER XXI Campaign Plan and the Army After Next initiatives.

(7) Recommend the establishment of appropriate atmospheric research and development programs based on documented Army requirements.

(8) Develop and coordinate long-range planning and programming for the division mission with ARL and publish the Directorate Strategic Long Range Plan.

(9) Formulate organizational budget requests for the Budget Year (subsequent fiscal year) for all program elements.

(10) Manage the financial resources during the execution and Five Year Defense Plan (FYDP) for the current and prior year.

4. **Atmospheric Effects Branch**

The mission of the Atmospheric Effects Branch is to improve the understanding of boundary layer processes of the battlefield and provide a means of implementation of these Army-scale processes for use by the Commander. This includes developing a capability for the Army to effectively detect and identify the presence of biological agents, both in situ, and remotely. It also includes research on first principal acoustic propagation models for use as battlefield decision aids. The branch provides enhanced knowledge of NBC hazard zones and the effects of local meteorology on various types of military operations. They perform theoretical and experimental investigations into nonlinear optical dynamics designed to develop systems capable of correcting severe phase distortion and improving image quality.

The Atmospheric Effects Branch was entirely relocated to Adelphi. These are the principal basic researchers in atmospheric physics. The Atmospheric Effects efforts address: (1) acoustic propagation and background models for predicting environmental effects on acoustic signatures and sources; (2) micrometeorology of urban and vegetative canopies, (3) optics and beam propagation in the boundary layer; (4) transport and diffusion of chemical/biological agents and other aerosols released into the atmosphere; and (5) in-situ and . . remote detection of chemical/biological agents and pollution aerosols. ARL BE performs associated boundary layer profiling research, with the FM-CW radar and Sodars, and acoustic field work, including the 56 foot long Mobile Acoustic Source, at Blossom Point, Maryland, upon completion of the site preparation and equipment refurbishment in FY98.

There are five teams within this branch. Their missions and functions follow:

(1) Atmospheric Transport & Diffusion Modeling Team

(a) Develop techniques and Parametrization methodologies for improving Large Eddy Simulation and micro meteorological models.

(b) Developments are being directed so that results can have a more direct application to command post tools such as Tactical Decision Aids.

(2) Atmospheric Acoustics Team

(a) Develop validated acoustic propagation and background models for assessing and predicting environmental **effects** of the atmosphere.

(b) Develop validated acoustic propagation models for assessing and predicting atmospheric turbulence, and land-sea interfaces on acoustic signatures as propagated from source to receiver.

(3) Chemical/Biological Research Team

(a) Provides atmospheric effects on stand off detection through both a **laboratory** research effort and a modeling effort.

(b) Simulate the effects of natural background **interferrents** such as bacteria spores, pollens, molds, and clay minerals using ultraviolet detection of agents.

(c) Investigate the potential for using circular polarization as an alternative to fluorescence detection. Explore new technologies for detection of **bioagents** such as Acoustic-Optical Tumble Filters **(AOTF)** and Optical Parametric Oscillator **(OPO)**.

(4) Boundary Layer Processes Team

(a) Establish a boundary layer field measurement facility

(b)Develop an inventory of Army relevant boundary layer and micro meteorological models/codes.

(5) Adaptive Optics

(a) Develop new techniques to mitigate optical turbulence effects

(b) Transition understanding of atmospheric effects to imaging and sensor technologies

(c) Develop capability using adaptive optics to permit target recognition in a cluttered environment.

5. **Synthetic Environments Branch**

The Synthetic Environments effort addresses: models and simulations of environmental effects on **electro-optical** systems and visualization of models and synthetic environments using realistic battlefield conditions. This branch develops and investigates research methods by which to model and depict the battlefield environment and to develop **scientific** methods by which to evaluate these models. Using a combination of models and both laboratory and field experiments, this branch **scientifically** describes both natural and battlefield environments. The branch consists of the following teams.

(1) Atmospheric **Electro-Optics** Team

(a) Develop a complete suite of models to be used for characterizing and simulating the **battlespace** atmospheric environment.

(b)Continue to develop experimental capabilities to determine the effects on **electro-optical** propagation.

(2) Virtual Proving Ground/Virtual Sand Table Team

(a) Develop tools to simulate dynamic terrain and dynamic cultural **features** to provide realism.

(b) Develop multi-level of detail at variable resolution

(c) Develop **efficient** algorithms and employ high performance and distributed computing techniques to increase the speed of physical rendering of models

(d) Develop a methodology for providing for interoperability between models based on model description language.

6. Weather Exploitation Branch

The Weather Exploitation efforts address: (1) **battlescale** forecasts of tactical weather, (2) tactical weather data assimilation and distribution, (3) advanced tactical decision aids integrated with tactical weather data products; and (4) transitioning advanced weather technology to Battlefield Automated Systems and Battle Laboratories. The mission of this branch is to develop and market Owning the Weather technologies to the warfighter

through Advanced **Warfighting** Experiments (AWES), Advanced **Technology** Demonstrations **(ATDs)** and other technical demonstrations for both Army and Air Force users. Develop automated capabilities to acquire weather data from **all** available sources on the battlefield and distribute information to Battlefield Automated Systems (BASS). The three teams and their functions are:

(1) Weather Intelligence Team

(a) Develop the capability for battlefield commanders to exploit weather as a combat multiplier to gain advantage over the enemy

(b) Enhance battle command effectiveness through the use of automated weather decision aids.

(2) Weather Effects Integration Team

(a) Develop, implement, and demonstrate **client/server** IMETS applications based upon **Battlescale** Forecast Model **(BFM)** forecasts of the battlefield environment.

(b) Integrate BFM and weather effects models for unified weather effects for operations, mission **rehearsal,** training and combat simulations

(3) Technology Transition Team

(a) Adapt the IMETS **client/server** approach to interface with environmental effects visualization models and combat simulation tools to provide a common, **unified** weather effects environment.

(b) Support Task Force XXI through deployment of battle command systems and on-site support of hardware and software tools.

7. **Artillery Meteorology Branch**

The Artillery Meteorology **efforts** include: (1) integration of tactical weather data and forecasts into artillery indirect fire and precision strike operations, and (2) remote sensing Profiler **technology** for artillery upper air soundings, which will transition in FY99 to the engineering developer for advanced **engineering** and fielding with the Army. The mission of this branch is to use Own the Weather technologies to enhance the warfighter's ability to exploit weather as a combat **multiplier** and execute precision strikes. This includes developing technologies to accurately predict **battlescale** and target area weather for use in automated weather effects decision aids that transform weather data into weather intelligence for Army Battle Command

System **(ABCS)** Battlefield Automated Systems (BASS). The two teams and their functions are:

(1) Met Systems and Fusion Team

(a) Develop a prototype mobile atmospheric profiler system, which when coupled with meteorological satellite and other battlefield met sources, eliminates the requirement for logistically burdensome artillery balloon borne sensor and hydrogen generators.

(b) Develop and demonstrate techniques to fuse atmospheric data from battlefield met data sources such as artillery met **systems,** wind radar profilers and radiometers, met satellites, UAV dropsondes and onboard met sensors, and automated in-situ surface sensors for a more coherent and timely measurement of battlefield met conditions.

(2) Computer Assisted Artillery Met Team

(a) Develop Computer Assisted Artillery Meteorology **(CAAM)** software that uses **fused** data and **mesoscale** meteorological modeling to more accurately predict **trajectory** and target area **meteorology**.

(b) Horizontally integrate **CAAM** data into artillery C41 systems to minimize met effects on indirect fire systems, and as a combat multiplier for deep attack planning and execution.

8. **Conclusion**

The reorganization and relocation of the Battlefield Environment Division has not changed any of the missions and functions of the organization. In fact, there are considerable advantages of synergy with the merging of atmospheric effects and synthetic environment with the Information Science and Technology Directorate which focuses on battlefield situation awareness through visualization, advanced telecommunications, **software** and intelligent systems research. As can be seen by the number of papers presented at this **Battlespace** Atmospherics Conference and in the past, the research continues to be excellent and the organization continues to achieve its mission of advancing our understanding of the atmosphere and its critical relationship to the performance of Army specific requirements, enabling land force dominance.